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Antibiotic resistance of bacteria along the food chain: A global challenge for food safety

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Le Monde.fr/ 10.03.14

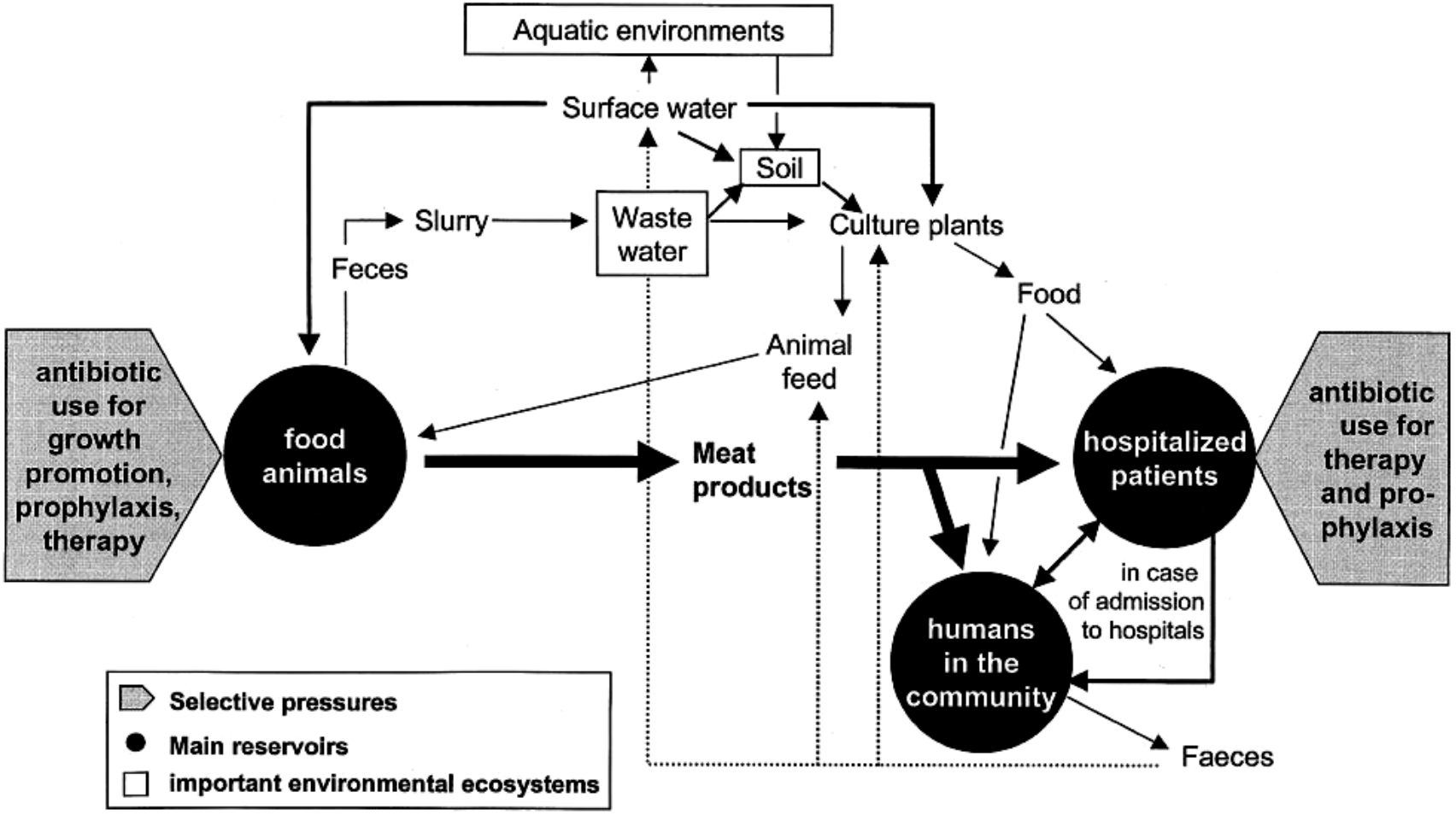
http://www.lemonde.fr/planete/article/2014/03/10/volailles-le-test-inquietant-de-l-ufc-que-choisir_4380588_3244.html

- 26 samples of which 61% contain resistant bacteria
- Conventional^{+}, organic and « Red Label» products
- Resistance to critical antibiotics

Antibiotics hazards

- Antibiotics are the most therapeutic agents used in animal food producing
- Bacterial resistance: Spread along the food chain and the environment
- Pathogens (*Salmonella*, *Campylobacter*, *E.coli*, *Staphylococcus aureus*)
- Commensal bacteria (reservoir)

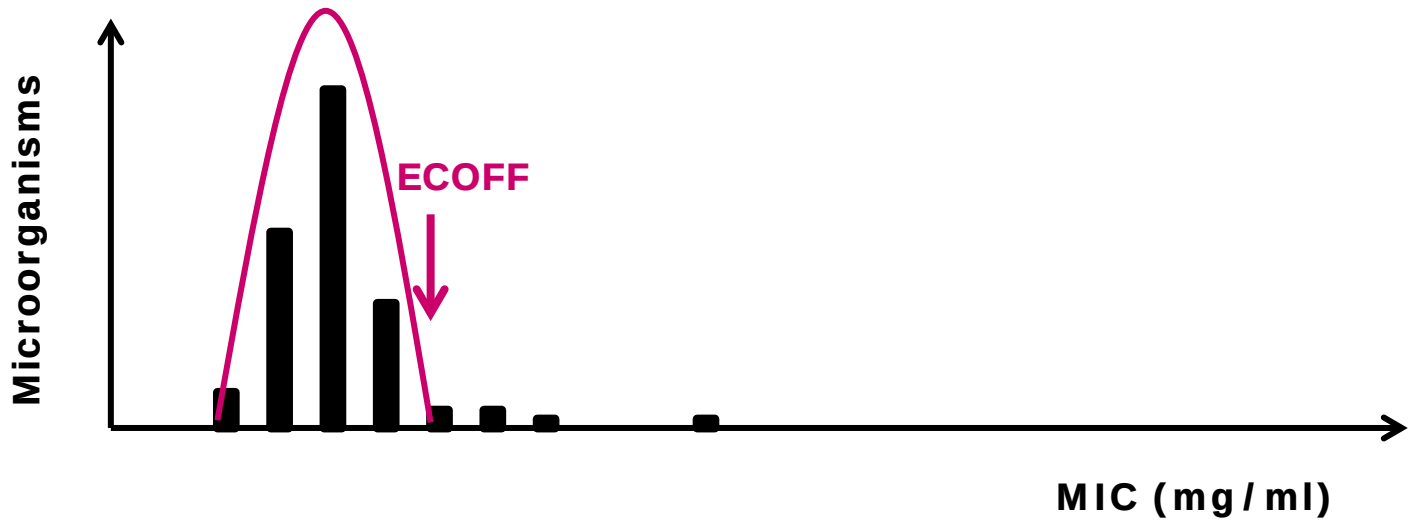
Routes of transmission of genes conferring antibiotic resistance.



Witte, IJAA 2000

Antibiotic resistance

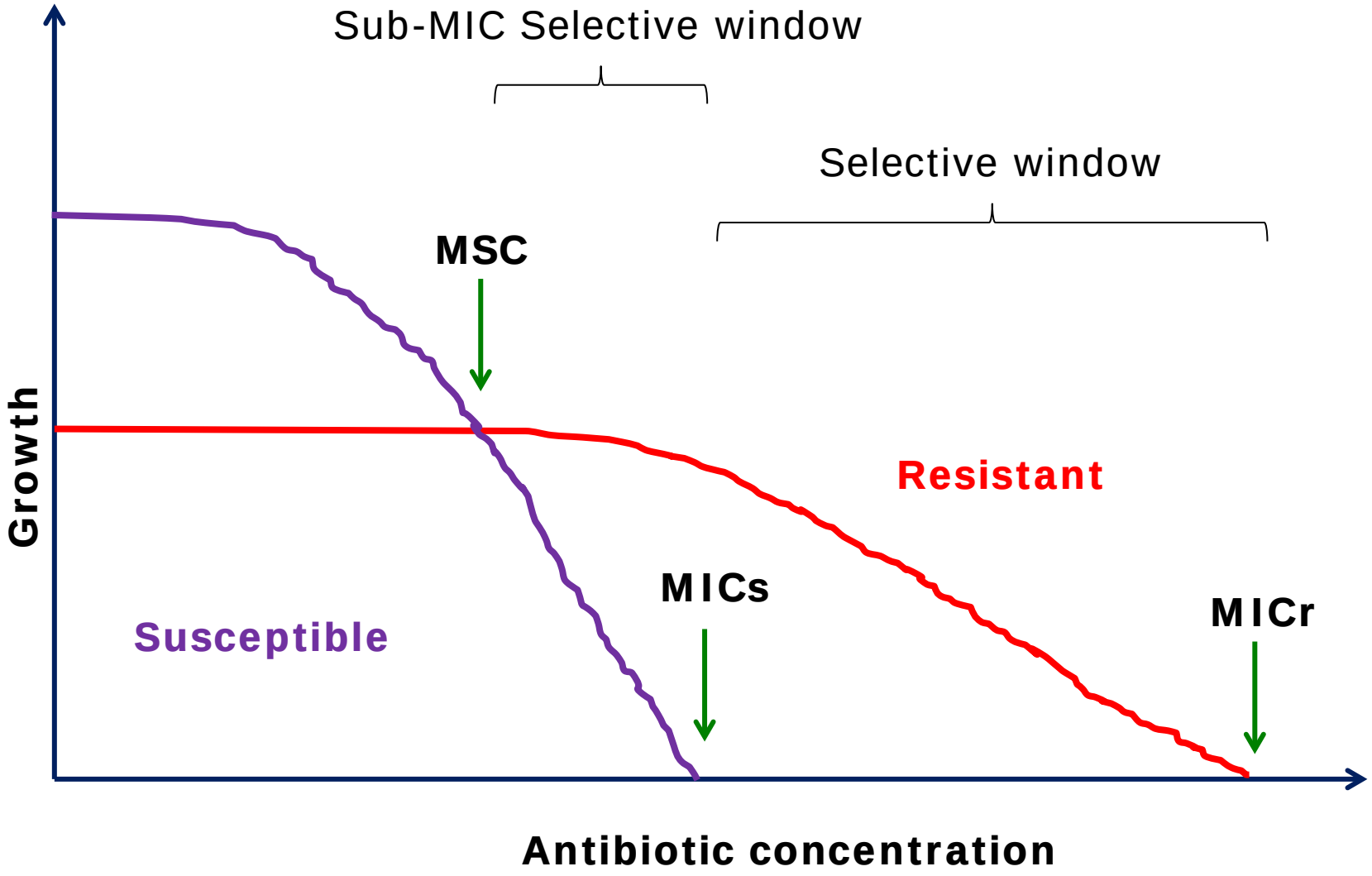
- Microbiological resistance
- Epidemiological Cut-off (ECOFF) value
- MIC separating the wild-type population/ resistant isolates (mutations, HGT)



Antibiotic resistance

- Health risks along the food chain
  - Zoonoses diseases
  - Spread of resistance genes to other pathogens of diverse origins (mobile elements...)

Implications on animal and human health; and on the microbial ecology of the environment.



Andersson and Hugues, FEMS 2011.

Antibiotic resistance

- Mutants of *E. coli* and *Salmonella enterica* with resistance to AB (TET, FQ, AG)
  - Selection of R bacteria can occur at AB concentrations up to several hundred-fold below the MIC of the S strains

- Ultralow antibiotic concentrations found in many natural environments are sufficiently high to confer the selection and persistence of antibiotic resistance.

Food production systems

- Ab are used as growth promoters
- Ab could be bought w/o prescription
- Residus of forbidden Ab (Chl, NF)
- Persistence of Ab in environment
- Persistence and dissemination of resistant genes even if no use corresponding Ab
- Lack of monitoring programmes

Food safety

Salmonella spp.

- Raw meat sold in market: Porc 39-64%; Chicken 42-53%; Beef 62%
- Resistance in meat: Porc 50-73% ; Chicken 45%
  - Tetracycline, sulphonamide, steptomycin, ampicillin, chloramphenicol, trimethoprim, nalidic acid
- Multiresistance : 21-56% of isolates
  - 7-9 antibiotics: 15% / 10-13 antibiotics: 8%

- Multiresistant *Salmonella* from food or food-producing animals are common in different countries:
  - Malaysia 49-75% (n=88)
  - Thailand 44-66% (n=342)
  - Vietnam 21-56% (n=180)

Thi Thu Hao Van et al. IJFM 2012; Truong Ha Thai et al. IJFM 2012; Thi Thu Hao Van et al. AEM 2007; Thi Thu Hao Van et al. IJFM 2008.

Food safety

Campylobacter spp.

- Chicken sold in market: 15.3%
- Chicken : 95% of strains are resistant to FQ

Escherichia coli : a reservoir

- Resistance: 84% of isolates of beef, poultry, porc
- Resistance to FQ: 52-63% in chicken
- Multiresistant *E. coli* (n=99) in raw meat:
  - 89.5% in chicken meat
  - 95% in chicken faeces
  - 75% in pork meat
- Chl-resistant *E.coli* in aquaculture (n=557)
  - Vietnam: 58.3%; Malaysia: 25%; Thaïlande: 31.8%

Garin et al. IJFM 2012; Van et al. IJFM 2012; Van et al. AEM 2007; Vo et al. 2010; Huys et al. RM 2007

AMR dissemination

- Large conjugative plasmids and integrons containing many antibiotic determinants have been found in:
  - *Salmonella* (35% and 13% respectively)
  - *E. coli* (76% and 57% respectively)

  in raw chicken and pork meats from the market place in Vietnam.

Van et al. 2008; Van et al. 2007

AMR dissemination

- China: Plasmid-mediated quinolone resistance in *E. coli* isolates from animals, farmworkers, and the farm environment in pig and chicken farms

- Transferable plasmid-mediated multidrug efflux pump gene *oqxAB* which was widespread in animal farms, was also detected in 30% of human commensal *E. coli* isolates from farmworkers without any previous antimicrobial treatment or hospital admission

Zhao, AAC 2010

AMR dissemination

- Comparison of AGP diet (2) and no AGP (28 d):
  - Similar prevalence *E. Coli* Amp^r/Tet^r (90%)
- Resistance patterns (n=25) were diverse from zero to resistance up to 9 different Ab
- Similar genetic profiles between meat/environment and hides/digesta isolates
- Contamination in slaughthering regardless the AGP administration

Alexander, IJFM 2010

Management system

Surveillance

AB use
Resistance
Detection

Decrease AB use

Health management
Reduce diseases
Alternatives

Proper use of AB

Diagnostic
Dose / lenght
Molecules

Contamination Control

Hygiene practices / BMP
Microbial control

Monitoring / Compliance
Knowlegde / Research
Int. Collaborations

Conclusion

Need for global approaches because AMR is a global food safety hazard and a public health concern